Moored time-series records for chlorophyll and turbidity collected from the LB1 Mooring, LB2 Mooring, LB3 Mooring in the South Atlantic Bight (SAB) continental shelf off Long Bay from 2011-2012 (Long Bay Wintertime Bloom project)

Website: https://www.bco-dmo.org/dataset/638349
Data Type: Other Field Results
Version: 1
Version Date: 2016-02-11

Project
» Mechanisms of nutrient input at the shelf margin supporting persistent winter phytoplankton blooms downstream of the Charleston Bump (Long Bay Wintertime Bloom)

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Abstract
Time series of chlorophyll and turbidity measured every second on three moorings located at Long Bay, S. Carolina in the South Atlantic Bight, located at mid-shelf at 30 m, shelf break at 74 m and upper slope at 171 m along a central shelf/slope survey line SE of Myrtle Beach, SC between 33.17/-78.33 and 32.76/-77.91.

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Coverage

Spatial Extent: **N**:33.17255 **E**:-78.01322 **S**:32.85237 **W**:-78.33
Temporal Extent: 2011-12-14 - 2012-04-04

Methods & Sampling

Mooring data records for optical sensors:

- LB_2012_LB1 mooring (30 m depth): Three ECO units were deployed, one on the bottom mooring frame (S/N 738) about 0.5 m above bottom, and two on a taut-line mooring attached to the frame, nominally at 15 m depth (S/N. 736) and 5 m depth (S/N 735). Sampling for the three LB1 ECO units was three consecutive 1-second readings at 6-minute (360 second) intervals.
- LB_2012_LB2 mooring (76 m depth): One ECO unit was deployed on the ADCP mooring frame about 0.5

m above bottom (S/N 739). This unit had an apparent electronic failure during the deployment which resulted in a distinct positive baseline shift for turbidity and negative baseline shift for chlorophyll. The data record was considered suspect at this point and only data from the initial deployment period (before the baseline shift) is reported. Sampling for the LB2 unit was three consecutive 1 second readings at 6-minute (360 second) intervals.

- LB_2012_LB3 mooring (171 m depth): The ECO unit (S/N 740) was mounted about 0.5 m above the bottom on the lower portion of the Floatation Technologies AL-200 Trawl Resistant Bottom Mount frame which held a 150 kHz ADCP unit. Due to the longer deployment period for the LB3 instrument and internal memory limitations, sampling was set for a single 1-second sample at 6-minute (360 second) intervals (instead of three 1-sec samples for the ECO units at LB1 and LB2).

Instrument calibrations and inter-comparisons: Manufacturer supplied calibration factors for chlorophyll concentration and turbidity were employed following pre- and post-deployment checks for consistency. The five ECO FLNTUSB units were serviced at WET Labs and calibrated as a set in May, 2011. Instrument inter-calibrations and the factory chlorophyll calibration factors were checked by obtaining a concurrent set of measurements in the water column before deployment. All ECO units were mounted on a piece of angle iron that was hung on a weighted line at the same depth as the ship's CTD/carousel system (20 m below the surface at the shelf break station LB2 to avoid surface irradiance effects on the chlorophyll fluorescence signal). The units were held at depth for 5 minutes (acquiring 4-5 readings). Niskin bottle water samples were collected about mid-point of the sampling period for chlorophyll analyses (triplicate filtered samples frozen and stored in liquid nitrogen on the ship, analyzed in the shore lab by the fluorometric method). After recovery of the moorings, the units were photographed to record bio-fouling. The four functioning ECO units (except for S/N 739) were then mounted on the ship's CTD/carousel frame for a post-deployment set of inter-comparison measurements at two depths in the water column (35 m and 10 m), again with Niskin samples collected for chlorophyll analyses. For chlorophyll estimated from fluorescence, the pre- and post-deployment readings showed agreement to within 0.1-0.15 mg/m3 for readings at a measured concentration of 0.4 mg/mg3 (both pre- and post-deployment) and 0.2 mg/m3 at a measured concentration of 1.25 mg/m3. For turbidity the pre-deployment check showed close agreement between all units (average 0.066 +/- 0.002 NTU at 20 m depth). The post-deployment check appeared to be compromised by drying of a film on the optical windows after recovery prior to the post-deployment checks. For the turbidity data records, baseline readings over the deployment periods (minimum values) only showed marked increase for S/N 738 deployed on the mooring frame at LB1 (increasing from about 0.4 to 1.2 NTU during the latter part of the deployment). For the data reported here, there has been no correction for the apparent increase in baseline readings for this instrument.

Wetlabs calibration sheets: See Supplemental Files

Internal Clock Drift: Time was recorded as UTC with internal clocks set to a common GPS-based reference during the pre-deployment set-up. Internal clock drift during deployments was checked against the reference after recovery. Temporal offsets at recovery ranged from -9 seconds to +528 seconds with an average offset of +359 seconds (or about the sampling interval of 360 seconds). Given that most events in the optical records occurred on time scales of hours to days, no clock drift correction was applied. Time stamps in raw files in the format MM/DD/YY HH:MM:SS were converted to the Microsoft Excel epoch convention (01/01/1900 = 1) and to the Matlab serial date number format (01/01/0000 = 1) for Excel and Matlab files respectively.

Data Processing Description

Chlorophyll was calculated from digital counts output data as:

Chl (ug/L) = Scale Factor * (Output Counts – Dark Counts)

Turbidity was calculated as:

NTU = Scale Factor * (Output Counts – Dark Counts)

Instrument-specific scale factors and dark counts for chlorophyll and turbidity provided on the WET Labs "FLNTU Characterization Sheet" were employed (see Related files and references). Raw data files were initially imported into Excel for calculations, then formatted for import into Matlab (including conversion of time stamps to the Matlab serial date format).

Examination of data records for the unit deployed at the shelf break mooring LB_2012_LB2 (S/N 740) indicated an electronic malfunction occurred at 14-Feb-2012 03:10:20. This resulted in a distinct positive shift in the output baseline for turbidity simultaneous with a distinct negative shift in the baseline for chlorophyll readings.

The subsequent chlorophyll record appeared only to capture peaks of higher concentration events. The data subsequent to this point was considered to be bad and was not included in the record submitted to the BCO-DMO.

BCO-DMO Processing:

-extracted data from MatLab .mat files
-added conventional header with dataset name, PI name, version date
-renamed some parameters to BCO-DMO standard
-added yrday_utc and ISO_DateTime_UTC to served view

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Data Files

File	
mooring_optics.csv	(Comma Separated Values (.csv), 15.89 MB) MD5:e68eac708bddf75daf323e88a67bbdeb
Primary data file for dataset ID 638349	

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Supplemental Files

File	
Wetlabs calibration sheet filename: FLNTUSB-735_temp_pres_charsheet.pdf	(Portable Document Format (.pdf), 16.40 KB) MD5:339df518b070b5520b09f5673cfe4c0f
Wetlabs calibration sheet filename: FLNTUSB-735_charsheet.pdf	(Portable Document Format (.pdf), 19.22 KB) MD5:88d612e104204a951c0bd1eb4e274847
Wetlabs calibration sheet filename: FLNTUSB-736_charsheet.pdf	(Portable Document Format (.pdf), 19.24 KB) MD5:8b5bed4a85801d0abd33cdca98bb7580
Wetlabs calibration sheet filename: FLNTUSB-738_charsheet.pdf	(Portable Document Format (.pdf), 19.24 KB) MD5:a319c03e357885e7af0bcbd24700ab5a
Wetlabs calibration sheet filename: FLNTUSB-739_charsheet.pdf	(Portable Document Format (.pdf), 19.21 KB) MD5:9bd888025ac0f9dbc042d15e125baf68
Wetlabs calibration sheet filename: FLNTUSB-740_charsheet.pdf	(Portable Document Format (.pdf), 19.22 KB) MD5:daa7c2c87018034feb1556ecd8cfe5ea

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Parameters

Parameter	Description	Units
deployment	mooring identification	unitless
location	description of deployment site	unitless
depth_w	mean water depth	meters
depth_n	nominal water depth at	meters
lat	latitude; north is positive	decimal degrees
lon	longitude; east is positive	decimal degrees
date_start	UTC date at beginning of data collection	yyyy-mm-dd
time_start	UTC time at beginning of data collection	HH:MM:SS
date_end	UTC date at end of data collection	yyyy-mm-dd
time_end	UTC time at end of data collection	HH:MM:SS
yrday_utc	year-day: UTC day and decimal time; as 326.5 for the 326th day of the year or November 22 at 1200 hours (noon).	day.part of day
ISO_DateTime_UTC	date/time (UTC) ISO formatted standard is based on ISO 8601:2004(E) and takes on any of the following forms: 2009-08-30T14:05:00Z (UTC time)	yyyy-mm-ddTHH:MM:SSZ
comment	comments	unitless
year	year	yyyy
month	month of year	mm
day	UTC day of month	dd
hour	UTC hour of day	HH
min	UTC minutes	MM
sec	UTC seconds	SS
chl_avg	Chlorophyll concentration; average of 3 sequential 1 sec samples	mg/m^3
chl_sd	Standard deviation of average of 3 sequential 1 second samples	mg/m^3
turb_avg	Turbidity; average of 3 sequential 1 second samples	NTU
turb_sd	Standard deviation of average of 3 sequential 1 second samples	NTU

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	WETLabs ECO-FLNTU
Generic Instrument Description	The ECO FLNTU is a dual-wavelength, single-angle sensor for simultaneously determining both chlorophyll fluorescence and turbidity.

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Deployments

LB_2012_LB1

Website	https://www.bco-dmo.org/deployment/58860
Platform	LB1 Mooring
Start Date	2012-01-20
End Date	2012-04-04
Description	Deployment of taut line and bottom frame at LB1 (at 31 m depth) during cruise SAV-12-02 on 20 January 2012. Recovered on 04 April 2012 during cruise SAV-12-14.

LB_2012_LB2

Website	https://www.bco-dmo.org/deployment/58861
Platform	LB2 Mooring
Start Date	2012-01-19
End Date	2012-04-03
Description	Deployment of SKIO Seahorse Profiler and bottom frame at LB2 (at 76 m depth) during cruise SAV-12-02 on 19 January 2012. Recovered on 03 April 2012 during cruise SAV-12-14.

LB_2012_LB3

Website	https://www.bco-dmo.org/deployment/58858
Platform	LB3 Mooring
Start Date	2011-12-14
End Date	2012-04-03
Description	Deployment of UNC bottom mooring at LB3 (at 171 m depth) during cruise SAV-11-44 on 14 December 2011. Recovered on 03 April 2012 during cruise SAV-12-14.

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Project Information

Mechanisms of nutrient input at the shelf margin supporting persistent winter phytoplankton blooms downstream of the Charleston Bump (Long Bay Wintertime Bloom)

Website: http://nccoos.org/projects/long-bay-wintertime-blooms/

Coverage: outer South Atlantic Bight (SAB) continental shelf off Long Bay

NSF Project Title: Mechanisms of nutrient input at the shelf margin supporting persistent winter phytoplankton blooms downstream of the Charleston Bump

Sustained phytoplankton blooms along the outer South Atlantic Bight (SAB) continental shelf off Long Bay are observed in winter in multi-year satellite chlorophyll imagery. This section of the shelf lies north of the "Charleston Bump" (between 32.5-33.5°N), where the Gulf Stream is often strongly deflected offshore. Due to this offshore deflection, this is not an area where nutrient input to the shelf would be enhanced by upwelling associated with Gulf Stream frontal eddies, a major mechanism of nutrient input in other parts of the SAB shelf (Lee et al., 1991). Yet prior in situ observations suggest that there is recurring input of nutrients from the upper slope to the outer shelf off Long Bay from winter to early spring. This project will investigate a fundamental aspect of physical-biological coupling in the outer shelf to upper slope region. The PIs will test the hypotheses that: 1) the persistence of winter blooms on the outer shelf off Long Bay results from repeated

episodes of nutrient input and mixing which maintains nutrient-sufficient conditions for extended periods; 2) several physical mechanisms are involved, including enhanced mixing energy from the internal tide along this section of the upper slope/shelf break; 3) the relatively high nutrient, intermittently turbulent environment will favor larger bloom-forming phytoplankton. The latter could have important implications for higher trophic levels, including early life history strategies of fish that spawn along the shelf margin off Long Bay in winter to early spring.

This project will combine several maturing observational technologies to address the following:

1. What is the frequency and magnitude on on-shelf transport of nitrate from the upper slope?
2. What are the mechanisms of nutrient delivery from the upper slope to the outer continental shelf zone that are operating off Long Bay under the range of hydrographic and forcing conditions encountered in winter?
3. What is the 3-D structure of outer shelf hydrography and associated winter bloom features and how do these evolve through multiple nutrient input/mixing events?
4. What are the rates of nitrate utilization and primary production associated with the winter blooms?
5. Does the winter regime consistently favor a bloom assemblage dominated by larger diatom forms?

Near-continuous cross-shelf and upper slope observations will be obtained with two autonomous gliders, time-series measurements on the outer shelf and slope from a set of moored instruments (including a moored profiling system at the shelf break), and repeated cross- and along-shelf ship surveys using a towed, undulating package. Ship station work will include measurements of primary production and on-board analyses of key functional characteristics of the phytoplankton assemblage (cell forms, abundance, size and bio-volume distributions) using a microfluidics/imaging system. In combination, these systems will provide a level of spatial and temporal resolution of physical, nutrient and biological fields that could not be achieved in earlier, station-based field studies and the basis for improved understanding of physical mechanisms of recurring nutrient input to the shelf, and how the nutrient, mixing, and circulation regime in winter structures the phytoplankton community. Coastal naturalists will be engaged through a seabird survey component of the field program that will augment existing information on pelagic seabirds in winter and define their association with oceanographic features on the central South Atlantic Bight shelf and slope.

This project will provide a deeper understanding of shelf/slope exchange processes and how these influence shelf ecosystems, generating information that will contribute to implementation of ecosystem-based management in the region.

References:
Lee, T. N., J. A. Yoder, and L. P. Atkinson, 1991: Gulf Stream frontal eddy influence on productivity of the southeast U.S. continental shelf. J. Geophys. Res, 96, 22191-22205.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1032285
NSF Division of Ocean Sciences (NSF OCE)	OCE-1032276

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